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(54) Subject of Invention
Catalytic Structure Body

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DETAILED DESCRIPTION

1. Subject of Invention

   Catalytic structure body

2. Scope of the Patent Claim

A catalytic structure body having the following characteristics: It is a catalytic structure body possessing a honeycomb structure; in the case where the pitch between the walls of the honeycomb structure of the structure body is 7 mm, the outer wall thickness of the structure body is set to be more than 2 mm; in the case where the pitch (between the walls of the honeycomb structure of the structure body) is other than the above (7 mm), the outer wall thickness of the structure body is set to be more than (2 X 21/n) mm [where n is the wall number of the honeycomb structure]; the wall thickness of the outer wall corner portion is set to be more than 1.1 times of the outer wall thickness; and the joining portion-cross section (area) between the outer wall portion of the inner wall portion of the honeycomb structure and the outer wall corner portion is shaped so that it is gradually increasing toward the outer wall and the outer wall corner portion.

3. Detailed Explanation of the Invention

[Industrial Application Field]

The present invention is related to an improvement of the catalytic structure bodies possessing a honeycomb structure. It is related to catalytic structure bodies possessing a honeycomb structure (including lattice shape structure) to be employed in removing the nitrogen oxides exhausted from power generation plants and other various plants.

[Conventional Technology]

Recently, the dry type exhaust denitrification equipments, by which the nitrogen oxides in the exhaust gas discharged from various combustion equipment are removed by catalyst contact reduction under the presence of ammonia according to the environmental regulation, are more widely employed than the wet type denitrification equipments because the former possess numerous advantages over the latter. Among them, the denitrification equipments utilizing the nitrogen oxides removal catalysts composed of honeycomb structure body are being put into practical uses widely because they possess

numerous advantages: the structure is simpler and the pressure loss is smaller; clogging of the catalyst by the dusts contained in the exhaust gases is minimal, etc.

However, since the catalyst used in denitrification is filled into the reactor to remove the nitrogen oxides in the exhaust gases, it is necessary to possess a sufficient strength to endure the exhaust gas pressure, vapor __ (one character not clearly printed) vibration, etc.

In general, there is a tendency that the performance of the honeycomb shape denitrification catalytic structure body would be lowered when its strength is increased. And the performance of the denitrification catalytic structure body would be enhanced by increasing its surface area contacting the (exhaust) gases. For enhancing the performance, it is better to make the inside wall thickness of the honeycomb structure as thin as possible. However, due to the required strength of the catalytic structure body, the thinning of the wall thickness has an upper limit. The development of high efficiency catalyst has been difficult so far.

[The Problematic Point to be Solved by the Invention]

The present invention is aimed to achieve a solution for the intrinsic opposing properties between the performance enhancement and strength enhancement present in the conventional honeycomb shape catalytic structure bodies as described above to provide a catalytic structure body which is superior in both the performance and the strength.

[The Means Used to Solve the Problematic Point]

For solving the above described problematic point, in the present invention, the strength of the honeycomb shape catalytic structure and the catalytic performance are respectively shouldered by the outside-use structure (outside wall, outside wall corner portion and their connecting portions with the inside wall) and the inside walls.

Namely, the present invention is a catalytic structure body having the following characteristics: It is a catalytic structure body possessing a honeycomb structure; in the case where the pitch between the walls of the honeycomb structure of the structure body is 7 mm, the outer wall thickness of the structure body is set to be more than 2 mm; in the

case where the pitch (between the walls of the honeycomb structure of the structure body) is other than the above (7 mm), the outer wall thickness of the structure body is set to be more than (2 X 21/n) mm [where n is the wall number of the honeycomb structure]; the wall thickness of the outer wall corner portion is set to be more than 1.1 times of the outer wall thickness; and the joining portion-cross section (area) between the outer wall portion of the inner wall portion of the honeycomb and the outer wall corner portion structure is shaped so that it is gradually increasing toward the outer wall and the outer wall corner portion.

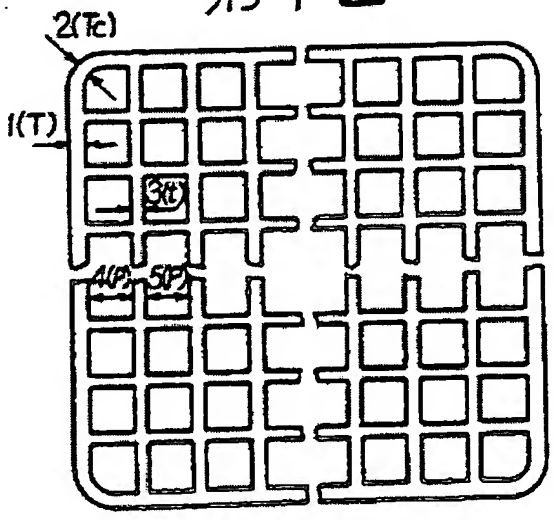
[Function]

Either by making the outside wall thickness and the outside wall corner portion thickness of the catalytic structure body thicker or by increasing the joining portion cross section of the inner wall and outer wall, the catalytic outermost circumference portion is set to be the strengthening member of the structure body to enhance the entire strength of the catalyst.

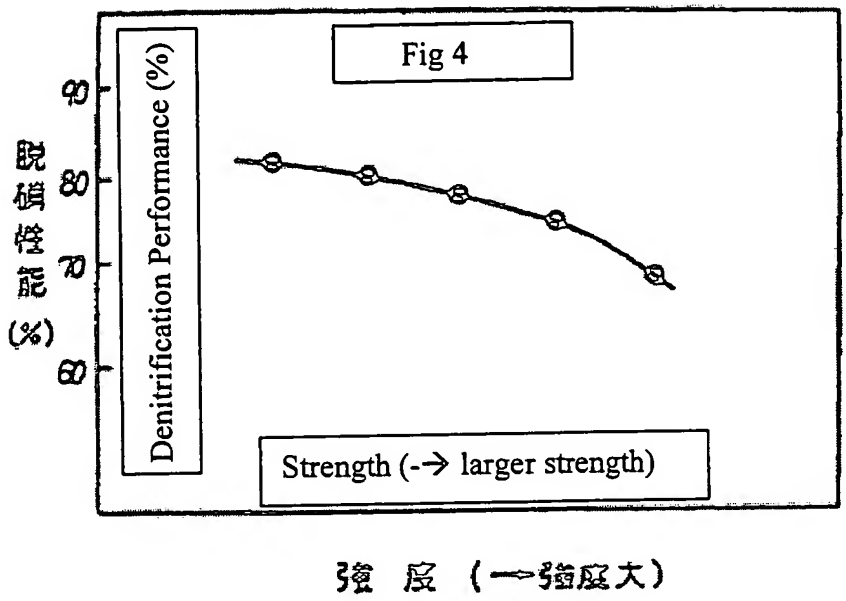
Below, the present invention is further described in details by referring to figures.

Fig 1 is a typical honeycomb shape catalytic structure body. It shows the cross section of a lattice shape catalytic structure body. In the present catalytic structure body, the thickness (T) of the outside wall 1 is identical to the thickness (Tc) of the outside wall corner portion 2. It is about 1.3 times (or 1.5 times, not clearly copied) of the thickness (t) of the inside wall 3. Presently, if the strength of the catalytic material is not increased, it has been difficult to make the strength of the catalytic structure body to become more than the required strength. Furthermore, in Fig 1, 4 is the pitch (p) between the inside wall 3 and the outside wall 1; 5 is the pitch (P) between the inside walls 3.

第1図



第4図

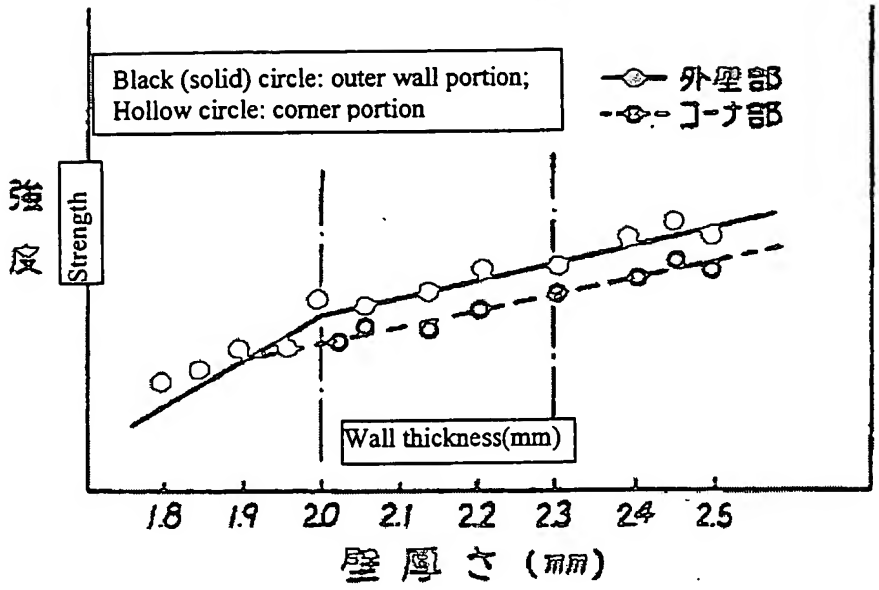


However, as shown in Fig 4, it has been verified that if the strength of the catalytic material is increased, the catalytic activity would be lowered. This means that for strengthening the strength by using the same catalytic material, it would become necessary to reduce the pores of the original pores of the catalytic material. From the general characteristics, it can be definitely deduced that the catalytic activity would be lowered if the pores are reduced.

In view of the above fact, the present inventors performed various tests for achieving enhancement in the catalytic structure body strength without requiring higher strength of the catalytic material. As a result, it was verified that the methods described below are effective and feasible for production.

(1) Due to the limitation imposed by the manufacturing (process), the size of the catalytic structure body has to be below 200 ⌟mm in maximal cross section and 1200 mm in length. The generally used ones are below 150 ⌟mm in cross section and 1000 mm in length. Accordingly, the present inventors carried out tests to find out the relationship between the thickness of the outer wall and the strength of the catalytic structure body on the catalytic structure body having 7 mm wall to wall spacing (pitch) and 21 wall number.

第5図



The results as shown in Fig 5 were obtained. In Fig 5, the black circle marks show the data on the outer wall portion and the hollow circle marks show the data on the outside wall corner portion.

It can be understood from Fig 5 that the relationship between the outer wall thickness and the strength of the catalyst is that the strength would increase with thicker outside wall thickness; however, when the outside wall thickness exceeds 2 mm, there is a tendency that the rate of increase is reduced. And, for making the strength of the outside wall corner portion to be identical to the strength of the outer wall, the thickness has to be made 10% more than the outside wall thickness.

The above is the result obtained for testing catalytic structure bodies possessing 7 mm pitch and 21 wall number. However, in the case where the pitch is other than 7 mm, it became clear that when the outer wall thickness of the structure body becomes more than (2 X 21/n) mm (n is the wall number), the rate of increase of the catalytic structure would be reduced. It became clear that in this case, for making the strength of the outside wall corner portion to be identical to the strength of the outer wall, the thickness has to be made 10% more than the outer wall thickness.

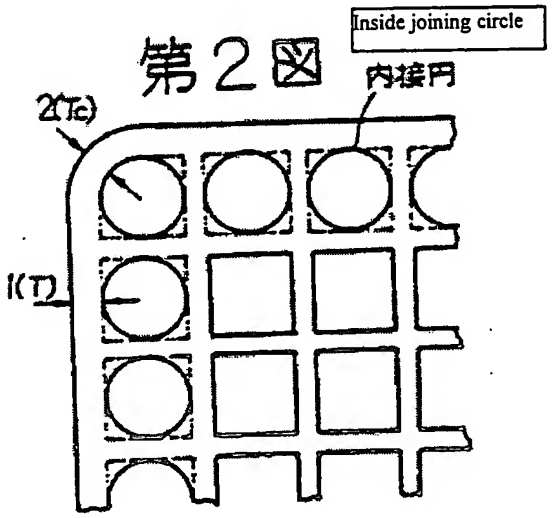
However, as the thickness of the outer wall and the outer wall corner portion is made thicker, the porosity would be reduced. This certainly means that there is a restriction to the upper limit on the thickness.

Accordingly, it is preferable that generally, in the case where the pitch between the walls of the honeycomb structure of the structure body is 7 mm, the outer wall thickness of the structure body is set to be more than 2 mm (or slightly thicker), in the case where the pitch is other than 7 mm, the outer wall thickness of the structure body is

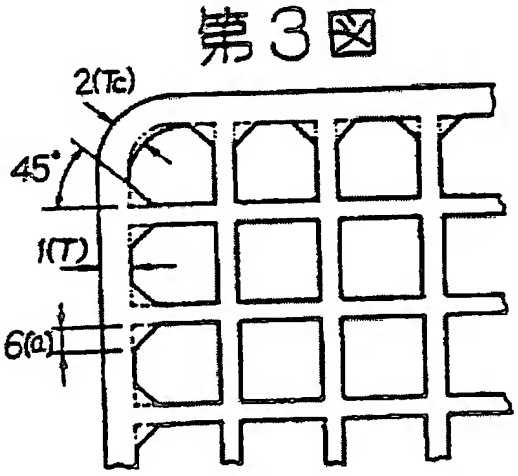
set to be (2 X 21/n) mm (or slightly thicker), and the wall thickness of the outer wall corner portion is set to be 1.1 times (or slightly more) of the outer wall thickness.

(2) And in the present invention, since the strength of the catalytic structure body is to be maintained by the outer circumference portion structure, the shape of the joining portion of the outer wall and the outer wall corner portion to the inner wall were examined. As a result, it became clear that it is preferable, as shown in the inside joining circular shape of Fig 2 and the corner attached shape of Fig 3, the joining portion thickness of the outer wall of the inner wall portion and the outer wall corner portion is shaped so that it is gradually increasing toward the outer wall and the outer wall corner portion. Furthermore, in Fig 2 and Fig 3, the symbols identical to those of Fig 1 indicate the same parts, and 6 is the length (a) of the corner portion. And the 2 point-dash line is an imaginary line.

第2図

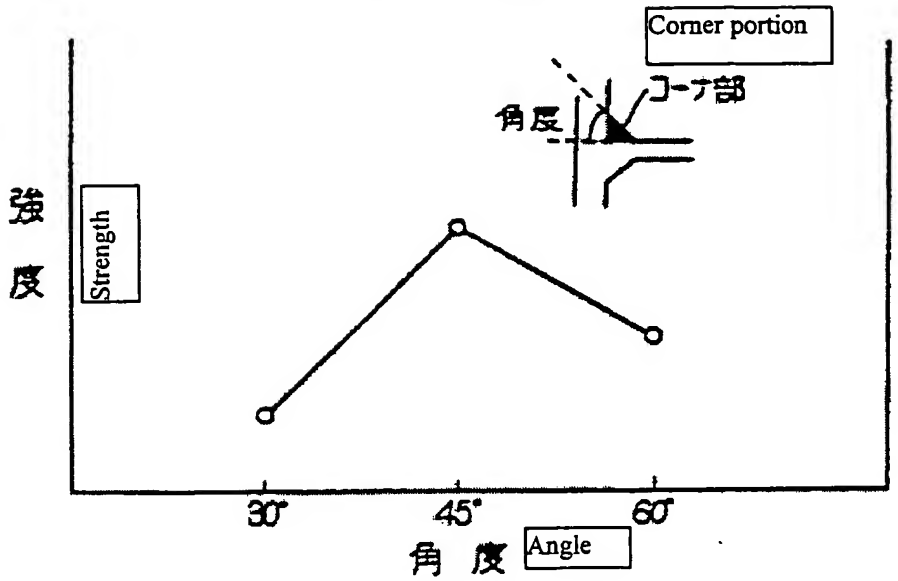


第3図



And the corner attached shape is as shown in Fig 6, if the corner area is constant, it is most advantageous to use the 45° 2 equilateral triangle shape. As shown in Fig 7, the corner portion length (a) is preferably to be set more than the thickness of the outer wall.

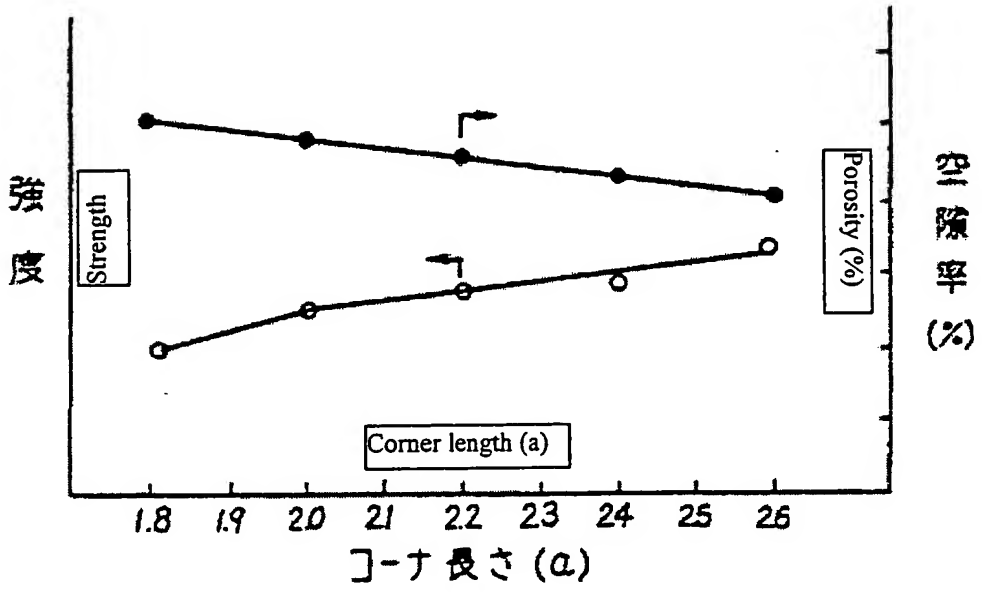
第6図



[Effect of the Invention]

By maintaining the required strength of the catalytic structure body by the outer circumference portion structure alone, the strength of the catalytic material itself can be made less critical. As a result, manufacturing of high activity catalyst would become possible. And by the same reason, the inner walls of the catalyst can be made thinner to enhance the activity by increasing the contacting surface of the catalyst.

第7図



4. Brief Explanation of Figures

Fig 1 is the cross section of a lattice shape catalytic structure for illustrating the honeycomb shape catalytic structure body of the present invention and the convention

kind. Fig 2 and Fig 3 are the cross section of the outer circumference structure of a lattice shape catalytic structure for illustrating the implementation modes of the catalytic structure of the present invention. Fig 4 is a diagram showing the relationship between the catalytic material strength and the catalytic activity. Fig 5 is a diagram showing the relationship between strength and the outer wall thickness and the corner portion thickness of the catalytic structure body. Fig 6 is a diagram showing the relationship between the angle of the outer wall corner portion and the strength of the catalytic structure body. Fig 7 is a diagram showing the relationship between the length of the outer wall corner portion and the strength of the catalytic structure body.

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審査請求　未請求　発明の数 1　（全4頁）

⑤4発明の名称　触媒構造体

⑳特　願　昭61－74356
㉒出　願　昭61(1986)4月2日

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明　細　書

1.発明の名称

触媒構造体

2.特許請求の範囲

ハニカム構造を有する触媒構造体であつて、該構造体のハニカム構造の壁と壁との間のピッチが7㎜ある場合は該構造体の外壁厚さを2㎜以上、該ピッチがそれ以外である場合は（2×21/n）㎜（但し、nはハニカム構造の壁数）以上とし、外壁コーナ部の壁厚を外壁厚の1.1倍以上とし、かつハニカム構造の内壁部の外壁部及び外壁コーナ部との接合部断面積を外壁及び外壁コーナ部に向つて漸増させる形状としてなることを特徴とする触媒構造体。

3.発明の詳細な説明

〔産業上の利用分野〕

本発明はハニカム構造を有する触媒構造体の改良に関し、火力発電所および各種工場等より排出される窒素酸化物の除去に使用されているハニカム構造（格子状構造を含む）を有する触媒構造体に関するものである。

〔従来の技術〕

最近、環境規制上各種の燃焼装置より排出される排ガス中の窒素酸化物をアンモニアの存在下で接触還元除去する乾式排煙脱硝装置は、湿式脱硝装置に比べ多くの利点を有するので近時多く使用されるようになつた。中でもハニカム構造体よりなる窒素酸化物除却用触媒を用いた脱硝装置は、構造が簡単で圧力損失が少なく、かつ排ガス中に含まれているダストによる触媒の目詰りが少ない等の優れた利点を数多く有するため、最も多く実用化されている。

しかしながら脱硝に用いられる触媒は、反応器に充填し排ガス中の窒素酸化物を除去するため、排ガス圧力及び気柱振動等に十分耐える強度を有する必要がある。

一般的にハニカム状脱硝触媒構造体は強度を強くすると性能が低下する傾向があり、又該脱硝触媒構造体はガスの接触する面積が増大する程性能が向上する。性能向上のためにはハニ

カム構造の内壁厚をできる限り薄くする方が良いが、該触媒構造体の必要強度上、壁厚は一定以上に限定され、高効率な触媒の開発が困難な状況であつた。

〔発明が解決しようとする問題点〕

本発明は上述したような従来のハニカム状触媒構造体に本質的に存在する性能向上と強度向上の相反する物性を、合目的に解決し、性能・強度とも優れた触媒構造体を提供しようとするものである。

〔問題点を解決するための手段〕

本発明は上述した問題点を解決するために、ハニカム状触媒構造物の強度を該構造物を外用部構造（外壁，外壁コーナ部と、それらと内壁との接合部）で、触媒性能を内壁で負担させるようにしたものである。

すなわち本発明はハニカム構造を有する触媒構造体であつて、該構造体のハニカム構造の壁と壁との間のピッチが7㎜ある場合は該構造体の外壁厚さを2㎜以上、該ピッチがそれ以外である場合は（2×21/n）㎜（但し、nはハニカム構造の壁数）以上とし、外壁コーナ部の壁厚を外壁厚の1.1倍以上とし、かつハニカム構造の内壁部の外壁部及び外壁コーナ部との接合部断面積を外壁及び外壁コーナ部に向つて漸増させる形状としてなることを特徴とする触媒構造体である。

〔作用〕

触媒構造体の外壁厚さ及び外壁コーナ部厚さを厚くするか、又は内壁と外壁との接合部断面積を増加させることにより触媒最外周部を構造体の強度部材とし、触媒全体の強度を向上させる。

以下、本発明を図面によつて更に詳述する。

第1図に代表的ハニカム状触媒構造体である格子状触媒構造体の断面を示す。現状触媒構造体では外壁1の厚さ（T）は外壁コーナ部2の厚さ（Tc）と同一厚さであり、内壁3の厚さ（t）の約1.3倍程度の厚さとなつているが、現状では触媒材質の強度を増加させないと触媒構造体の強度を必要以上にすることが困難な状況である。なお第1図中、4は内壁3と外壁1とのピッチ（P）、5は内壁3間のピッチ（P）である。

ところが第4図に示す通り触媒材質の強度を上昇させると触媒活性が低下することが判明している。これは同一触媒材質の構造体で強度を強くするためには、触媒材質が本来有する細孔を減少させる必要があり、細孔が減少すれば触媒活性が低下する触媒の一般的性格からも当然推定しうることである。

以上の事実より触媒材質の強度を高めることなく触媒構造体強度を向上させんとして本発明者らは種々テストを行い下記方法が有効でかつ製造可能であることが判つた。

(1) 触媒構造体の大きさは製造上の限界から、最大断面積200□㎜、長さ1200㎜以下であり、通常使用されているものは断面積150□㎜、長さ1000㎜以下である。そこで本発明者らは、壁と壁との間隔（ピッチ）7㎜、壁数21個の触媒構造体につき、外壁の厚さと触媒構造体の強度の関係につきテストした結果、第5図に示したような結果が得られた。第5図において黒丸は外壁部、白丸は外壁コーナ部のデータである。

触媒の外壁厚さと強度の関係は、この第5図から判るように強度は外壁厚さが厚くなるに従つて増加するが、外壁厚さ2㎜以上では増加率は減少する傾向にある。又、外壁コーナ部の強度は外壁と同一強度とするためには、外壁の厚さより10％増加する必要があることがわかる。

以上は、ピッチ7㎜、壁数21個の触媒構造物をテストした結果であるが、ピッチ7㎜以外の触媒構造物の場合には、外壁の厚さが2×21/n（nは壁数）㎜以上で触媒構造物の増加率は減少することがわかつた。この際においても外壁コーナ部の強度を外壁と同一とするためには、外壁の厚さより10％増加させる必要があつた。

しかしながら、外壁及び外壁コーナ部の厚

さを厚くするにしたがつて触媒構造体の空隙率は減少するので、当然これら厚さの上限は制限されることは言うまでもない。

従つて、一般的にはピッチ7㎜の触媒構造体においては、外壁の厚さを2㎜（又はそれよりやや厚め）、それ以外のピッチの触媒構造体においては外壁の厚さを（2×21/n）㎜（又はそれよりやや厚め）に設定し、かつ外壁コーナ部の厚さを外壁の厚さの1.1倍（又はそれよりやや厚め）に設定するのがよい。

(2) 又、本発明は外周部構造で触媒構造体の強度を保持するものであるので、外壁及び外壁コーナ部と内壁との接合部の形状をテストした結果、第2図に示す内接円形状及び第3図に示すコーナ付き形状のように、内壁部の外壁及び外壁コーナ部との接合厚さを外壁及び外壁コーナ部に向つて漸増させる形状とするのがよいことがわかつた。なお、第2図、第3図において第1図と同一符号は第1図と同一部を示し、6はコーナ部の長さ（a）を示す。

第5図は触媒構造体の外壁厚さ及びコーナ部厚さと強度の関係を示すグラフ、第6図は触媒構造体の外壁コーナ部の角度と強度の関係を示すグラフ、第7図は触媒構造体の外壁コーナ部の長さと強度の関係を示すグラフである。

又2点鎖線は仮想線である。

又コーナ付き形状は第6図に示す通りコーナ部面積が一定ならば45°の二等辺三角形の形状の場合がもつともすぐれており、第7図に示す通りコーナ部長さ（a）は外壁厚さ以上とすることが好ましい。

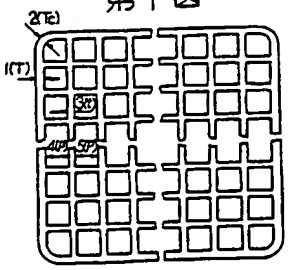
（発明の効果）

触媒構造体の必要強度を外周部構造のみで保持することにより触媒材質自身の強度がそれほど必要なくなり、高活性触媒の製造が可能となる。又、触媒内壁を同一理由により薄肉化が可能になり、触媒の接触面の増加により高活性化が可能となる。

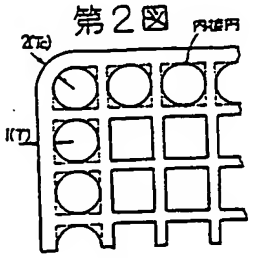
4.図面の簡単な説明

第1図は、本発明及び従来のハニカム状触媒構造体を説明するためのもので格子状触媒構造物の断面図、第2図及び第3図は本発明触媒構造物の実施態様を説明するためのもので、格子状触媒構造物の外周部構造の断面図、第4図は触媒材質強度と触媒活性の関係を示すグラフ、

第1図



第2図



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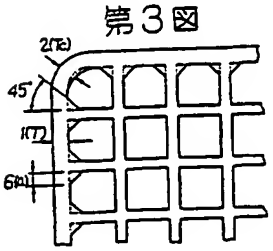
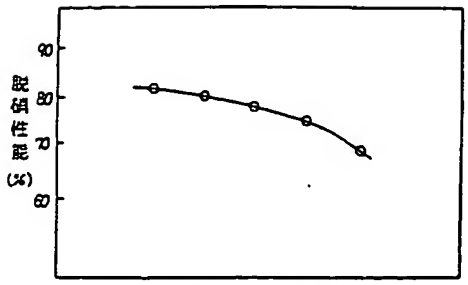


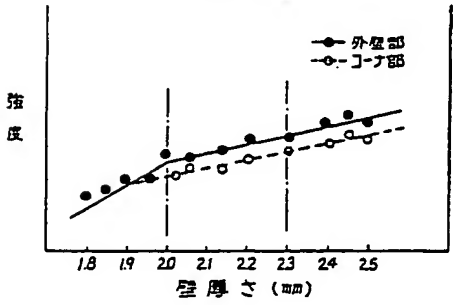
復代理人　内田　明
復代理人　萩原亮一
復代理人　安西篤夫

第4図

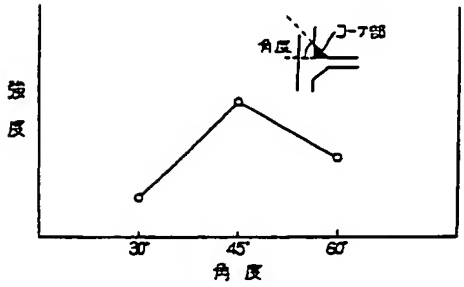


強 度（→強度大）

第5図



第6図



第7図